

This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found [here](#).

If you have a suggestion to make the keys better, please fill out the short survey [here](#).

*Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.*

1. Simplify the expression below into the form  $a + bi$ . Then, choose the intervals that  $a$  and  $b$  belong to.

$$\frac{-72 - 77i}{-2 - 5i}$$

The solution is  $18.24 - 7.10i$ , which is option D.

- A.  $a \in [17.5, 19]$  and  $b \in [-207.5, -205]$

$18.24 - 206.00i$ , which corresponds to forgetting to multiply the conjugate by the numerator.

- B.  $a \in [-10, -7.5]$  and  $b \in [17, 19]$

$-8.31 + 17.72i$ , which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

- C.  $a \in [528, 530]$  and  $b \in [-8.5, -5]$

$529.00 - 7.10i$ , which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

- D.  $a \in [17.5, 19]$  and  $b \in [-8.5, -5]$

\*  $18.24 - 7.10i$ , which is the correct option.

- E.  $a \in [35.5, 36.5]$  and  $b \in [15, 16]$

$36.00 + 15.40i$ , which corresponds to just dividing the first term by the first term and the second by the second.

**General Comment:** Multiply the numerator and denominator by the \*conjugate\* of the denominator, then simplify. For example, if we have  $2 + 3i$ , the conjugate is  $2 - 3i$ .

2. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 2^2 + 17 \div 4 * 14 \div 20$$

The solution is 1.975, which is option A.

- A.  $[1.2, 4.2]$

\* 1.975, this is the correct option

- B.  $[-4.9, -0.1]$

-0.985, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

- C.  $[4.6, 9.2]$

7.015, which corresponds to two Order of Operations errors.

D. [9.5, 10.2]

9.975, which corresponds to an Order of Operations error: multiplying by negative before squaring.  
For example:  $(-3)^2 \neq -3^2$

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{2156}{14}}$$

The solution is Irrational, which is option C.

A. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

B. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

C. Irrational

\* This is the correct option!

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to  $-\sqrt{154}$ .

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to \*not\* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1872}{8}} + 4i^2$$

The solution is Irrational, which is option D.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Pure Imaginary

This is a Complex number  $(a + bi)$  that **only** has an imaginary part like  $2i$ .

C. Rational

These are numbers that can be written as fraction of Integers (e.g.,  $-2/3 + 5$ )

D. Irrational

\* This is the correct option!

E. Nonreal Complex

This is a Complex number  $(a + bi)$  that is not Real (has  $i$  as part of the number).

**General Comment:** Be sure to simplify  $i^2 = -1$ . This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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5. Simplify the expression below and choose the interval the simplification is contained within.

$$15 - 18^2 + 20 \div 2 * 12 \div 13$$

The solution is  $-299.769$ , which is option B.

A.  $[346.23, 354.23]$

348.231, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example:  $(-3)^2 \neq -3^2$

B.  $[-300.77, -290.77]$

\*  $-299.769$ , this is the correct option

C.  $[338.06, 344.06]$

339.064, which corresponds to two Order of Operations errors.

D.  $[-311.94, -306.94]$

$-308.936$ , which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

**General Comment:** While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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6. Simplify the expression below into the form  $a + bi$ . Then, choose the intervals that  $a$  and  $b$  belong to.

$$\frac{-54 + 44i}{-7 - 5i}$$

The solution is  $2.14 - 7.81i$ , which is option E.

A.  $a \in [2.1, 2.8]$  and  $b \in [-579, -577.5]$

$2.14 - 578.00i$ , which corresponds to forgetting to multiply the conjugate by the numerator.

- B.  $a \in [157.85, 159]$  and  $b \in [-8.5, -7.5]$

$158.00 - 7.81i$ , which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

- C.  $a \in [7.75, 8.45]$  and  $b \in [-1.5, 0]$

$8.08 - 0.51i$ , which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

- D.  $a \in [7.15, 8.05]$  and  $b \in [-9.5, -8]$

$7.71 - 8.80i$ , which corresponds to just dividing the first term by the first term and the second by the second.

- E.  $a \in [2.1, 2.8]$  and  $b \in [-8.5, -7.5]$

\*  $2.14 - 7.81i$ , which is the correct option.

**General Comment:** Multiply the numerator and denominator by the \*conjugate\* of the denominator, then simplify. For example, if we have  $2 + 3i$ , the conjugate is  $2 - 3i$ .

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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{441}{100}}$$

The solution is Rational, which is option B.

- A. Irrational

These cannot be written as a fraction of Integers.

- B. Rational

\* This is the correct option!

- C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

- D. Integer

These are the negative and positive counting numbers (... , -3, -2, -1, 0, 1, 2, 3, ...)

- E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

**General Comment:** First, you **NEED** to simplify the expression. This question simplifies to  $\frac{21}{10}$ .

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to \*not\* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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8. Simplify the expression below into the form  $a + bi$ . Then, choose the intervals that  $a$  and  $b$  belong to.

$$(8 + 5i)(4 + 9i)$$

The solution is  $-13 + 92i$ , which is option D.

A.  $a \in [74, 82]$  and  $b \in [49, 56]$

$77 + 52i$ , which corresponds to adding a minus sign in the first term.

B.  $a \in [31, 36]$  and  $b \in [43, 51]$

$32 + 45i$ , which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C.  $a \in [-18, -9]$  and  $b \in [-93, -88]$

$-13 - 92i$ , which corresponds to adding a minus sign in both terms.

D.  $a \in [-18, -9]$  and  $b \in [88, 98]$

$-13 + 92i$ , which is the correct option.

E.  $a \in [74, 82]$  and  $b \in [-60, -48]$

$77 - 52i$ , which corresponds to adding a minus sign in the second term.

**General Comment:** You can treat  $i$  as a variable and distribute. Just remember that  $i^2 = -1$ , so you can continue to reduce after you distribute.

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9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{1078}{0}} + \sqrt{90}i$$

The solution is Not a Complex Number, which is option D.

A. Pure Imaginary

This is a Complex number ( $a + bi$ ) that **only** has an imaginary part like  $2i$ .

B. Irrational

These cannot be written as a fraction of Integers. Remember:  $\pi$  is not an Integer!

C. Nonreal Complex

This is a Complex number ( $a + bi$ ) that is not Real (has  $i$  as part of the number).

D. Not a Complex Number

\* This is the correct option!

E. Rational

These are numbers that can be written as fraction of Integers (e.g.,  $-2/3 + 5$ )

**General Comment:** Be sure to simplify  $i^2 = -1$ . This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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10. Simplify the expression below into the form  $a + bi$ . Then, choose the intervals that  $a$  and  $b$  belong to.

$$(9 - 3i)(-10 - 4i)$$

The solution is  $-102 - 6i$ , which is option D.

A.  $a \in [-104, -96]$  and  $b \in [1, 9]$

$-102 + 6i$ , which corresponds to adding a minus sign in both terms.

B.  $a \in [-93, -87]$  and  $b \in [9, 15]$

$-90 + 12i$ , which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

C.  $a \in [-81, -70]$  and  $b \in [-69, -58]$

$-78 - 66i$ , which corresponds to adding a minus sign in the first term.

D.  $a \in [-104, -96]$  and  $b \in [-11, 1]$

\*  $-102 - 6i$ , which is the correct option.

E.  $a \in [-81, -70]$  and  $b \in [66, 70]$

$-78 + 66i$ , which corresponds to adding a minus sign in the second term.

**General Comment:** You can treat  $i$  as a variable and distribute. Just remember that  $i^2 = -1$ , so you can continue to reduce after you distribute.

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